HIGH-RESOLUTION AND GAPLESS DUAL COMB SPECTROSCOPY WITH CURRENT-TUNED QUANTUM CASCADE LASERS

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We present gapless, high-resolution absorption and dispersion spectra obtained with quantum cascade laser frequency combs covering 55 cm^{-1}. Using a phase-sensitive dual comb design, the comb lines are gradually swept over 10 GHz, corresponding to the free spectral range of the laser devices, by applying a current modulation. We show that with interleaving the spectral point spacing is reduced by more than four orders of magnitude from 9.8 GHz down to 300 kHz over the full spectral span of the frequency comb. The noise equivalent absorbance (NEA) is 7x10^{-5} Hz$^{-1/2}$ and 1x10^{-3} Hz$^{-1/2}$ for strong and weak comb lines, respectively. The potential of this technique for high-precision gas sensing is illustrated by measuring the low pressure (107 hPa) absorption and dispersion spectra of methane spanning the range of 1170 cm^{-1}-1225 cm^{-1}within only 120 ms.[1]

In short, quantum cascade laser dual-comb spectroscopy with laser current modulation and interleaving enables acquisition of absorption spectra on a broad spectral range with sub-second temporal resolution, sub-MHz spectral resolution, and outstanding NEA.

[1] M. Gianella et al., Optics Express 28, 6197-6208 (2020), doi: 10.1364/OE.379790.